

Amendments to the Claims:

The following listing of claims will replace all prior versions and/or listings of claims in the application:

Listing of Claims:

1-2269 (cancelled)

2270. (previously presented): A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation; and
allowing the heat to transfer from the one or more heaters to a selected section of the formation such that a porosity of a majority of at least a portion of the selected section increases substantially uniformly.

2271. (previously presented): The method of claim 2270, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least two heaters pyrolyzes at least some hydrocarbons within the selected section of the formation.

2272. (previously presented): The method of claim 2270, further comprising maintaining a temperature within the selected section within a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C.

2273. (previously presented): The method of claim 2270, wherein at least one of the one or more heaters comprises an electrical heater.

2274. (previously presented): The method of claim 2270, wherein at least one of the one or more heaters comprises a surface burner.

2275. (previously presented): The method of claim 2270, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

2276. (previously presented): The method of claim 2270, wherein at least one of the one or more heaters comprises a natural distributed combustor.

2277. (original): The method of claim 2270, further comprising controlling a pressure and a temperature within at least a majority of the selected section of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

2278. (original): The method of claim 2270, further comprising controlling the heat such that an average heating rate of the selected section is less than about 1 °C per day during pyrolysis.

2279. (currently amended): The method of claim 2270, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more ~~heat sources~~ heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (P_{wr}) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

2280. (original): The method of claim 2270, wherein allowing the heat to transfer comprises transferring heat substantially by conduction.

2281. (previously presented): The method of claim 2270, wherein allowing the heat to transfer to the selected section of the formation heats the selected section to increase a thermal conductivity of at least a portion of the selected section to greater than about 0.5 W/(m °C).

2282. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

2283. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins.

2284. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15.

2285. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen.

2286. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen.

2287. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur.

2288. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols.

2289. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by weight of the condensable hydrocarbons are aromatic compounds.

2290. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings.

2291. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes.

2292. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes.

2293. (previously presented): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

2294. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises ammonia, and wherein greater than about 0.05 % by weight of the produced mixture is ammonia.

2295. (original): The method of claim 2270, further comprising producing a mixture from the formation, wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer.

2296. (original): The method of claim 2270, further comprising controlling a pressure within at least a majority of the selected section of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

2297. (original): The method of claim 2270, further comprising controlling formation conditions to produce a mixture from the formation, wherein a partial pressure of H₂ within the mixture is greater than about 0.5 bar.

2298. (previously presented): The method of claim 2270, further comprising producing a mixture from the formation, wherein a partial pressure of H₂ within the mixture is measured when the mixture is at a production well.

2299. (original): The method of claim 2270, further comprising altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.

2300. (original): The method of claim 2270, further comprising producing a mixture from the formation and controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation.

2301. (original): The method of claim 2270, further comprising:

providing hydrogen (H₂) to the heated section to hydrogenate hydrocarbons within the section; and

heating a portion of the section with heat from hydrogenation.

2302. (original): The method of claim 2270, further comprising:

producing hydrogen and condensable hydrocarbons from the formation; and

hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

2303. (previously presented): The method of claim 2270, wherein allowing the heat to transfer increases a permeability of a majority of the selected section to greater than about 100 millidarcy.

2304. (previously presented): The method of claim 2270, wherein allowing the heat to transfer increases a permeability of a majority of the selected section such that the permeability of the majority of the selected section is substantially uniform.

2305. (original): The method of claim 2270, further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay.

2306. (previously presented): The method of claim 2270, further comprising producing a mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

2307. (currently amended): The method of claim 2270, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of ~~heat sources~~heaters, and wherein the unit of heaters comprises a triangular pattern.

2308. (currently amended): The method of claim 2270, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of ~~heat sources~~heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

2309-5395 (cancelled)

5396. (previously presented): The method of claim 2306, wherein at least about 20 heaters are disposed in the formation for each production well.

5397. (previously presented): A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation; and
allowing the heat to transfer from the one or more heaters to a part of the formation such that a porosity of a majority of the part increases substantially uniformly.

5398. (previously presented): The method of claim 5397, wherein the heat is allowed to transfer from the one or more heaters to at least a portion of the part to establish a pyrolysis zone in the part of the formation.

5399. (previously presented): The method of claim 5397, wherein the heat is allowed to transfer from the one or more heaters to at least a portion of the part to establish a pyrolysis zone proximate to and/or surrounding at least one heater in the part of the formation.

5400. (previously presented): The method of claim 5397, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

5401. (previously presented): The method of claim 5397, further comprising maintaining a temperature within the part within a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C.

5402. (previously presented): The method of claim 5397, wherein at least one of the one or more heaters comprises an electrical heater.

5403. (previously presented): The method of claim 5397, wherein at least one of the one or more heaters comprises a surface burner.

5404. (previously presented): The method of claim 5397, wherein at least one of the one or more heaters comprises a flameless distributed combustor.

5405. (previously presented): The method of claim 5397, wherein at least one of the one or more heaters comprises a natural distributed combustor.

5406. (previously presented): The method of claim 5397, wherein at least one of the one or more heaters comprises a natural distributed combustor, the method further comprising allowing oxidizing fluid to react with at least some hydrocarbons within a reaction zone to generate heat in the reaction zone and transferring the generated heat substantially by conduction from the reaction zone to the part.

5407. (previously presented): The method of claim 5397, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

5408. (previously presented): The method of claim 5397, further comprising controlling the heat such that an average heating rate of the part is less than about 1 °C per day during pyrolysis.

5409. (currently amended): The method of claim 5397, wherein providing heat from the one or more heaters to at least the portion of the formation comprises:

heating a selected volume (V) of the hydrocarbon containing formation from the one or more ~~heat sources~~ heaters, wherein the formation has an average heat capacity (C_v), and wherein the heating pyrolyzes at least some hydrocarbons within the selected volume of the formation; and

wherein heating energy/day (Pwr) provided to the selected volume is equal to or less than $h * V * C_v * \rho_B$, wherein ρ_B is formation bulk density, and wherein an average heating rate (h) of the selected volume is about 10 °C/day.

5410. (previously presented): The method of claim 5397, wherein allowing the heat to transfer comprises transferring heat substantially by conduction.

5411. (previously presented): The method of claim 5397, wherein allowing the heat to transfer to the part of the formation heats the part to increase a thermal conductivity of at least a portion of the part to greater than about 0.5 W/(m °C).

5412. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

5413. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 0.1 % by weight to about 15 % by weight of the condensable hydrocarbons are olefins.

5414. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises non-condensable hydrocarbons, and wherein a molar ratio of ethene to ethane in the non-condensable hydrocarbons ranges from about 0.001 to about 0.15.

5415. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is nitrogen.

5416. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is oxygen.

5417. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 1 % by weight, when calculated on an atomic basis, of the condensable hydrocarbons is sulfur.

5418. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons comprise oxygen containing compounds, and wherein the oxygen containing compounds comprise phenols.

5419. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein greater than about 20 % by weight of the condensable hydrocarbons are aromatic compounds.

5420. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons,

and wherein less than about 5 % by weight of the condensable hydrocarbons comprises multi-ring aromatics with more than two rings.

5421. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein less than about 0.3 % by weight of the condensable hydrocarbons are asphaltenes.

5422. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons, and wherein about 5 % by weight to about 30 % by weight of the condensable hydrocarbons are cycloalkanes.

5423. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises a non-condensable component, wherein the non-condensable component comprises molecular hydrogen, wherein the molecular hydrogen is greater than about 10 % by volume of the non-condensable component, and wherein the molecular hydrogen is less than about 80 % by volume of the non-condensable component.

5424. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises ammonia, and wherein greater than about 0.05 % by weight of the produced mixture is ammonia.

5425. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein the produced mixture comprises ammonia, and wherein the ammonia is used to produce fertilizer.

5426. (previously presented): The method of claim 5397, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

5427. (previously presented): The method of claim 5397, further comprising controlling formation conditions to produce a mixture from the formation, wherein a partial pressure of H₂ within the mixture is greater than about 0.5 bar.

5428. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation, wherein a partial pressure of H₂ within the mixture is measured when the mixture is at a production well.

5429. (cancelled)

5430. (previously presented): The method of claim 5397, further comprising producing a mixture from the formation and controlling formation conditions by recirculating a portion of hydrogen from the mixture into the formation.

5431. (previously presented): The method of claim 5397, further comprising:
providing hydrogen (H₂) to the heated section to hydrogenate hydrocarbons within the section; and
heating a portion of the section with heat from hydrogenation.

5432. (previously presented): The method of claim 5397, further comprising:
producing hydrogen and condensable hydrocarbons from the formation; and
hydrogenating a portion of the produced condensable hydrocarbons with at least a portion of the produced hydrogen.

5433. (previously presented): The method of claim 5397, wherein allowing the heat to transfer increases a permeability of a majority of the part to greater than about 100 millidarcy.

5434. (previously presented): The method of claim 5397, wherein allowing the heat to transfer increases a permeability of a majority of the part such that the permeability of the majority of the part is substantially uniform.

5435. (previously presented): The method of claim 5397, further comprising controlling the heat to yield greater than about 60 % by weight of condensable hydrocarbons, as measured by the Fischer Assay.

5436. (previously presented): The method of claim 5397, further comprising producing a mixture in a production well, and wherein at least about 7 heaters are disposed in the formation for each production well.

5437. (previously presented): The method of claim 5436, wherein at least about 20 heaters are disposed in the formation for each production well.

5438. (currently amended): The method of claim 5397, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of ~~heat sources~~heaters, and wherein the unit of heaters comprises a triangular pattern.

5439. (currently amended): The method of claim 5397, further comprising providing heat from three or more heaters to at least a portion of the formation, wherein three or more of the heaters are located in the formation in a unit of ~~heat sources~~heaters, wherein the unit of heaters comprises a triangular pattern, and wherein a plurality of the units are repeated over an area of the formation to form a repetitive pattern of units.

5440-5466 (cancelled)

5467. (previously presented): A method of treating a hydrocarbon containing formation in situ, comprising:

providing heat from one or more heaters to at least a portion of the formation;
allowing the heat to transfer from the one or more heaters to a part of the formation such that a porosity of a majority of at least a portion of the part increases substantially uniformly; and
altering a pressure within the formation to inhibit production of hydrocarbons from the formation having carbon numbers greater than about 25.

5468. (previously presented): The method of claim 5467, wherein the one or more heaters comprise at least two heaters, and wherein superposition of heat from at least two heaters pyrolyzes at least some hydrocarbons within the part of the formation.

5469. (previously presented): The method of claim 5467, further comprising maintaining a temperature within the part within a pyrolysis temperature range, wherein the pyrolysis temperature range is from about 250 °C to about 370 °C.

5470. (previously presented): The method of claim 5467, further comprising controlling a pressure and a temperature within at least a majority of the part of the formation, wherein the pressure is controlled as a function of temperature, or the temperature is controlled as a function of pressure.

5471. (previously presented): The method of claim 5467, further comprising producing a mixture from the formation, wherein the produced mixture comprises condensable hydrocarbons having an API gravity of at least about 25°.

5472. (previously presented): The method of claim 5467, further comprising controlling a pressure within at least a majority of the part of the formation, wherein the controlled pressure is at least about 2.0 bar absolute.

5473. (previously presented): The method of claim 5467, wherein allowing the heat to transfer increases a permeability of a majority of the part such that the permeability of the majority of the part is substantially uniform.

5474. (previously presented): The method of claim 5467, wherein the part of the formation comprises a selected section.

5475. (previously presented): The method of claim 5467, wherein the heat is allowed to transfer from the one or more heaters to at least a portion of the part of the formation to establish a pyrolysis zone in the part of the formation.

5476. (previously presented): The method of claim 5467, wherein the heat is allowed to transfer from the one or more heaters to at least a portion of the part of the formation to establish a pyrolysis zone proximate to and/or surrounding at least one of the one or more heaters in the part of the formation.